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1. Untranslatable words are replaced with asterisks (\*).
2. Texts in the figures are not translated and shown as is.

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**FULL CONTENTS**

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**[Claim(s)]**

[Claim 1]The 1st active material that covered nickel hydroxide with oxy cobalt hydroxide.

The 2nd active material that covered nickel oxyhydroxide with oxy cobalt hydroxide.

It is the non-sintering nickel pole for encapsulated type alkaline batteries provided with the above, and mixed use of the 1st active material and 2nd active material is carried out with a wt. ratio of 90:10-60:40.

[Claim 2]The 1st active material that covered nickel hydroxide with oxy cobalt hydroxide.

The 2nd active material that covered nickel oxyhydroxide with oxy cobalt hydroxide.

It is the non-sintering nickel pole for encapsulated type alkaline batteries provided with the above, and mixed use of the 1st active material and 2nd active material is carried out with a wt. ratio of 80:20-70:30.

[Claim 3]The non-sintering nickel pole for encapsulated type alkaline batteries according to claim 1 or 2, wherein oxy cobalt hydroxide is added at 1.0 to 10.0weight % of a rate by atomic conversion of cobalt to nickel hydroxide in said 1st active material.

[Claim 4]The non-sintering nickel pole for encapsulated type alkaline batteries according to claim 1 or 2, wherein oxy cobalt hydroxide is added at 1.0 to 10.0weight % of a rate by atomic conversion of cobalt to nickel oxyhydroxide in said 2nd active material.

[Claim 5]Nickel hydroxide in said 1st active material Zinc, magnesium, Calcium, manganese, aluminum, cadmium, yttrium, The non-sintering nickel pole for encapsulated type alkaline batteries containing at least one sort of elements chosen from a group which consists of cobalt, bismuth, lanthanum, ytterbium, erbium, gadolinium, and cerium according to claim 1 or 2.

[Claim 6]Nickel oxyhydroxide in said 2nd active material Zinc, magnesium, Calcium,

manganese, aluminum, cadmium, yttrium, The non-sintering nickel pole for encapsulated type alkaline batteries containing at least one sort of elements chosen from a group which consists of cobalt, bismuth, lanthanum, ytterbium, erbium, gadolinium, and cerium according to claim 1 or 2.

[Claim 7] Claim 1 or an encapsulated type alkaline battery using the non-sintering nickel pole according to claim 2.

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#### [Detailed Description of the Invention]

[0001]

[The technical field to which this invention belongs] With respect to the battery which used the non-sintering nickel pole for encapsulated type alkaline batteries, and its nickel pole, this invention reduces electric discharge reserve in detail, and relates to improvement of the active material aiming at providing the nickel pole for encapsulated type alkaline batteries which moreover excelled [ high capacity ] in the high rate discharging characteristic.

[0002]

[The conventional \*\*\*\*\*] Conventionally, the sintering type nickel pole make an active material (nickel hydroxide) come to impregnate at the sintered carrier which obtained it by making a pierced steel plank etc. sinter nickel powder as an anode of encapsulated type alkaline batteries, such as a nickel hydrogen storage battery and a nickel cadmium storage battery, is known well.

[0003] In order to increase the fill ration of an active material on a sintering type nickel pole, it is necessary to use a sintered carrier with large porosity. However, since the combination between the nickel particles by sintering is weak, if porosity of a sintered carrier is enlarged, a nickel particle will drop out of a sintering type board easily. Therefore, porosity of a sintered carrier cannot be practically made larger than 80%. So, there is a problem that there are few active material fill rations in a sintering nickel pole. Generally, 10 micrometers or less and since the aperture of the sintered compact of nickel powder is small, it also has the problem that restoration to the sintered carrier of an active material must be performed by the solution impregnating method which needs to repeat a complicated impregnation process several times.

[0004] Since it is such, the non-sintering nickel pole represented on the paste type nickel pole is proposed these days. A paste type nickel pole is produced by filling up a substrate with large porosity with the kneaded material (paste) of an active material (nickel hydroxide) and binders (methyl cellulose solution etc.). Since a substrate with large porosity can be used (the substrate of not less than 95% of porosity can be used), while being able to increase the fill

ration of an active material, the restoration to the substrate of an active material is easy on the paste type nickel pole.

[0005]However, if a substrate with large porosity is used in order to increase the fill ration of an active material on a paste type nickel pole, the current collection nature of a substrate will worsen and an active material utilization factor will fall.

[0006]Then, adding cobalt hydroxide  $[\text{Co}(\text{OH})_2]$  as a conducting agent to nickel hydroxide is proposed in order to raise the active material utilization factor of a paste type nickel pole (refer to JP, S61-49374, A). Cobalt divalent cobalt hydroxide oxidizes to cobalt trivalent oxy cobalt hydroxide (beta-CoOOH) by first-time charge, and this forms a conductive network and raises an active material utilization factor.

[0007]By the way, a nickel hydrogen storage battery and a nickel cadmium storage battery enlarge negative electrode capacity compared with anode capacity, and even if the full charge of the anode is carried out, they are designed so that an uncharged portion (the theoretical capacity of this uncharged portion is hereafter called "charge reserve".) may exist in the negative electrode. [ this charge reserve ] . [ by making the oxygen gas ( $2\text{OH}^-$  -

$>1/2\text{O}_2 + \text{H}_2\text{O} + 2\text{e}^-$ ) emitted from an anode at a charging end term and the time of an overcharge absorb with the negative electrode ] (-- case [ of a cadmium pole ]: --  $\text{Cd} + 1/2\text{O}_2 + \text{H}_2\text{O} \rightarrow \text{Cd}(\text{OH})_2$ ; -- case [ of a hydrogen pole ]: , although there are some which are provided in order to control the rise of the internal pressure of  $2\text{MH} + 1/2\text{O}_2 \rightarrow 2\text{M} + \text{H}_2\text{O}$ ) and an encapsulated type battery, It also has the work which controls the fall of the electric discharge capacity especially based on decline in the active material utilization factor of the negative electrode at the time of high rate discharge.

[0008]The oxidization to oxy cobalt hydroxide at the time of the charge in the above-mentioned conventional paste type nickel pole from cobalt hydroxide is irreversible. That is, it is not returned at the time of electric discharge, but the oxy cobalt hydroxide generated at the time of charge is still oxy cobalt hydroxide. Therefore, the quantity of electricity which the oxidization to oxy cobalt hydroxide from cobalt hydroxide took will be stored in the negative electrode as potential electric discharge quantity of electricity ("electric discharge reserve" is called hereafter.). A charge-and-discharge reaction is not a perfect reversible reaction, either. That is, the nickel oxyhydroxide generated by charge is not completely returned to nickel hydroxide by electric discharge. Therefore, quantity of electricity equal to the difference of the charge quantity of electricity which oxidization of positive active material took in first-time charge and discharge, and the electric discharge quantity of electricity which reduction took is stored in the negative electrode as electric discharge reserve.

[0009]Since the rate of the active material which can actually be used became small when the

rate of the electric discharge reserve occupied to the active material with which the battery was filled up is large, there was a problem that the capacity of a battery fell. Then, it is considered to be effective to high-capacity-izing of a battery to reduce electric discharge reserve.

[0010]However, since there is work which controls the cell voltage fall by the rise of negative electrode potential in the electric discharge last stage at the time of high rate discharge in electric discharge reserve, even if there are too few rates of the electric discharge reserve occupied in negative electrode capacity, the electric discharge capacity in high rate discharge falls. Therefore, in order to obtain the non-sintering nickel pole which gives an alkaline battery with large electric discharge capacity in high rate discharge, it is necessary to design the amount of irreversible reactions of an anode so that electric discharge reserve may become proper.

[0011]It is equal to making proper the difference of the charge quantity of electricity in first-time charge and discharge, and electric discharge quantity of electricity to make electric discharge reserve proper. As an anode conducting agent, it replaces with cobalt hydroxide, and if the oxy cobalt hydroxide proposed by JP,H8-24041,B is used, since neither oxidization nor reduction is carried out by charge and discharge, oxy cobalt hydroxide can make zero (0) electric discharge reserve which originates in an anode conducting agent and is generated.

[0012]When the active material mixture containing the nickel hydroxide powder, nickel oxyhydroxide powder, and cobalt powder which are proposed by JP,S60-254564,B is used, The electric discharge reserve for the quantity of electricity which oxidization of cobalt takes can be reduced by adding nickel oxyhydroxide.

[0013]However, since electric discharge reserve of the negative electrode is the total quantity of the electric discharge reserve which originates in the electric discharge reserve and positive active material which originate in an anode conducting agent and are generated, and is generated, if the electric discharge reserve which originates in positive active material and is generated is not decreased, either, it cannot make electric discharge reserve proper.

[0014]

[Problem to be solved by the invention]Therefore, an object of this invention is to provide the non-sintering nickel pole which makes the suitable electric discharge reserve for the negative electrode which makes it possible to produce an encapsulated type alkaline battery with large electric discharge capacity in high rate discharge generate.

[0015]

[Means for solving problem]In order to attain the above-mentioned purpose, [ the non-sintering nickel pole for encapsulated type alkaline batteries concerning this invention ] The 1st active material that covered nickel hydroxide with oxy cobalt hydroxide, It is a non-sintering nickel pole for alkaline batteries which consists of the 2nd active material that covered nickel oxyhydroxide with oxy cobalt hydroxide, and mixed use of the 1st active material and 2nd

active material is carried out with the wt. ratio of 90:10-60:40.

[0016]Here, when the wt. ratio of the 2nd active material that comprises nickel oxyhydroxide is less than 10 weight %, the amount of irreversible reactions of the anode in a charge-and-discharge reaction increases, and electric discharge reserve of the negative electrode becomes excessive. As a result, since the rate of the active material which can actually be used among the active materials with which the battery was filled up falls, the fall of capacity arises. On the other hand, when the wt. ratio of the 2nd active material that comprises nickel oxyhydroxide exceeds 40 weight %, the reversible reaction in a charge-and-discharge reaction increases, and electric discharge reserve becomes [ too little ]. As a result, it becomes impossible to fully control the rise of the electric discharge last stage and the negative electrode potential at the time of high rate discharge, and the electric discharge capacity of the battery at the time of high rate discharge falls. Therefore, mixed use of the 1st active material and 2nd active material is carried out with the wt. ratio of 90:10-60:40.

[0017]It enables a cycle characteristic to improve further by carrying out mixed use of the 1st active material and 2nd active material with the wt. ratio of 80:20-70:30.

[0018][ nickel hydroxide of the 1st active material as positive active material and/, or the 2nd active material and/, or nickel oxyhydroxide ] At least one sort of elements chosen from zinc, magnesium, calcium, manganese, aluminum, cadmium, yttrium, cobalt, bismuth, lanthanum, ytterbium, erbium, gadolinium, and cerium may be made to dissolve. The expansion of positive active material can be controlled by making these elements dissolve.

[0019]Here, the nickel oxyhydroxide used for the 2nd active material prepares nickel hydroxide, and it can produce it easily by carrying out predetermined time (usually for 3 to 60 minutes) immersion, for example, agitating in the solution which added alkali, such as sodium hydroxide, in hydrogen peroxide solution and hypochlorite solution. The Reason for adding the above-mentioned alkali is for raising the pH of solution and promoting the oxidization to nickel oxyhydroxide.

[0020]The oxy cobalt hydroxide which covered nickel hydroxide of the 1st active material and/, or the 2nd active material and/, or nickel oxyhydroxide is 1.0 to 10.0 weight % to nickel hydroxide powder and nickel oxyhydroxide powder by the ratio in atomic conversion of cobalt. Since an active material utilization factor falls when the coating volume is less than 1.0 weight %, and in order that [ when the amount of the said addition exceeds 10.0 weight %, ] the fill ration of nickel hydroxide may decrease, also when it is any, electric discharge capacity falls.

[0021]The above-mentioned oxy cobalt hydroxide which covers an active material is easily producible by carrying out predetermined time immersion and oxidizing, agitating cobalt hydroxide for example, in the solution which added alkali, such as sodium hydroxide, to the oxidizer solution. Weak acid-ized agents, such as potassium peroxodisulfate, can also be used for oxidization of cobalt hydroxide outside oxidants, such as hydrogen peroxide and

hypochlorite.

[0022]Separately, as a line, the oxidization to the nickel oxyhydroxide of nickel hydroxide and the oxidization to oxy cobalt hydroxide of cobalt hydroxide are good, and an oxidant may be used and they may be performed at once, respectively.

[0023]With the application of this invention, as a suitable non-sintering nickel pole for encapsulated type alkaline batteries, the paste which contains the 1st active material of the above and the 2nd active material in a conductive axis is applied, and the paste type nickel pole to dry is mentioned. As an example of the conductive axis at this time, nickel foam, a felt-like metal fiber porous body, and a punching metal are mentioned. The tube shape nickel pole where a tube shape metal conductor is filled up with an active material outside this, The pocket-like nickel pole fill up a pocket-like metal conductor with an active material, and an active material are applied to the nickel pole for button type batteries etc. which carry out pressing with the metal conductor of netted form, and it is suitable.

[0024]As an example of a suitable encapsulated type alkaline battery, a nickel hydrogen storage battery (negative electrode: hydrogen storing metal alloy electrode), a nickel cadmium storage battery (negative electrode: cadmium electrode), and a nickel zinc storage battery (negative electrode: zinc electrode) are mentioned, using this invention electrode as an anode.

[0025]Since nickel hydroxide and nickel oxyhydroxide as positive active material are covered with oxy cobalt hydroxide as a conducting agent, respectively, [ this invention electrode ] [ nickel oxyhydroxide ] When this is used as an anode of an encapsulated type alkaline battery, electric discharge reserve of the negative electrode can be freely controlled by the mixing ratio of the 1st active material and the 2nd active material, and the amount of electric discharge reserve can be made proper with it. For this reason, the encapsulated type alkaline battery which uses this invention electrode has the large electric discharge capacity in high rate discharge.

[0026]

[Mode for carrying out the invention]Although this invention is hereafter explained still in detail based on an embodiment, in the range which is not limited to the following embodiment at all and does not change the gist, it changes suitably and this invention can be carried out.

[Experiment 1] In this experiment 1, in order to investigate the predominance of this invention electrode, the comparison with an electrode was performed conventionally.

(Embodiment 1)

The nickel hydroxide 100g is dropped in 1000 ml of solution of the <production of 1st active material> cobalt sulfate 13.1g, and it is dropped, agitating 1 mol/l. of sodium hydroxide solution, and the pH of liquid is adjusted to 11. Then, agitation mixing was carried out for 1 hour, and the \*\* exception produced a flush and the nickel hydroxide particle powder which

carried out suction drying and covered the surface with cobalt hydroxide. When the pH of liquid is supervised with a pH meter (glass electrode with automatic focusing) during the above-mentioned immersion and the pH of liquid falls, suitably, the above-mentioned sodium hydroxide solution is dropped and pH is held to 11.

[0027]In order to change the above-mentioned cobalt hydroxide to oxy cobalt hydroxide, it processes in the following procedure. First, the nickel hydroxide particle powder 100g which covered the surface with the above-mentioned cobalt hydroxide is immersed for 10 minutes, agitating 30weight % to 1000 ml of sodium hydroxide, and a mixed water solution with 50 ml of 12 weight % sodium hypochlorite aqueous solutions. Then, it washed, and it dried and the \*\* exception obtained the nickel oxyhydroxide particle powder (the 1st active material) which had the surface covered with oxy cobalt hydroxide.

[0028]In this 1st active material, to nickel hydroxide, oxy cobalt hydroxide is atomic conversion of cobalt, and is added 5weight %. The content of this oxy cobalt hydroxide is calculated as follows.

[0029]Content (weight % by atomic conversion of cobalt) =  $100 \times \frac{\text{weight of cobalt sulfate} \times (\text{atomic weight of cobalt atom})}{(\text{molecular weight of cobalt sulfate}) \times (\text{weight of nickel hydroxide})}$

[ the particle powder 100g which consists of nickel hydroxide covered with cobalt hydroxide in production of the 1st active material of the <production of 2nd active material> above ] It was immersed for 10 minutes, agitating 30weight % to a mixed water solution with 1000 ml of sodium hydroxide, and 1000 ml of 12 weight % sodium hypochlorite aqueous solutions. Then, it washed and dried and the \*\* exception produced the nickel oxyhydroxide particle powder (the 2nd active material) which covered the surface with oxy cobalt hydroxide. In the case of the above-mentioned immersion treatment, cobalt hydroxide and nickel hydroxide have oxidized to oxy cobalt hydroxide and nickel oxyhydroxide, respectively.

[0030]In this 2nd active material, to nickel oxyhydroxide, oxy cobalt hydroxide is atomic conversion of cobalt, and is added 5weight %. The content of this oxy cobalt hydroxide is calculated as follows.

[0031]Content (weight % by atomic conversion of cobalt) =  $100 \times \frac{\text{weight of cobalt sulfate} \times (\text{atomic weight of cobalt atom})}{(\text{molecular weight of cobalt sulfate}) \times (\text{weight of nickel oxyhydroxide})}$

The 1st active material obtained with the <production of non-sintering nickel pole> above <production of the 1st active material> and the 2nd active material produced by doing in this way were mixed by the weight ratio 80:20.

[0032]Knead this mixed granule child 100 weight section and 1 weight % methyl cellulose solution 20 weight section as a binder, and a paste is prepared, It was filled up with this paste in the pore of the nickel foam (95% of porosity, 200 micrometers of average pore sizes) which

is a conductive base, and it dried, and pressing was carried out and the non-sintering nickel pole was produced.

<production of an encapsulated type alkaline battery> -- this non-sintering nickel pole (anode). The encapsulated type alkaline battery (theoretical capacity: about 1000 mAh(s)) A1 of AA size was produced using a polyamide nonwoven fabric (separator), the 30 weight % potassium hydroxide solution (electrolytic solution), metal battery cans, metal battery lids, etc. The ratio of anode capacity to negative electrode capacity was set to 1:2. Also in the following embodiments and comparative examples, all the ratios of anode capacity to negative electrode capacity were set to 1:2.

(Embodiment 2) Ammonium sulfate salt was added in the solution which mixed zinc sulfate with nickel sulfate by the weight ratio 99.5:0.5, and nickel and zinc ammine complex ion were formed in it. This liquid was dropped at sodium hydroxide solution, and zinc produced the nickel hydroxide which dissolved 0.5weight %. The 1st active material was obtained by the same method as Embodiment 1 using this nickel hydroxide 100g. The 2nd active material used the same thing as the above-mentioned Embodiment 1. Except that the 1st active materials differed, the non-sintering nickel pole and the encapsulated type alkaline battery A2 were obtained like Embodiment 1.

(Embodiment 3) It replaced with the sodium hypochlorite aqueous solution 12weight % at 1000 ml, and the non-sintering nickel pole and the encapsulated type alkaline battery A3 were obtained like Embodiment 1 except having used 1000 ml of hydrogen peroxide solution 31weight %.

(Comparative example 1) Nickel hydroxide 100 weight section, cobalt hydroxide 7.9 weight section (they are five weight sections by cobalt atom conversion), and 1 weight % methyl cellulose solution 20 weight section as a binder were kneaded, and the paste was adjusted. Into the pore of nickel foam (95% of porosity, 200 micrometers of average pore sizes), it filled up and dried, pressing of this paste was carried out, and the non-sintering nickel pole was produced. This non-sintering nickel pole is the conventional electrode of the indication to JP,S61-49374,A. The encapsulated type alkaline battery X was produced like Embodiment 1 except having used this non-sintering nickel pole as an anode.

(Comparative example 2), [ the nickel hydroxide 100g and the 1 cobalt oxide 6.3g ] Supply to 1000 ml of potassium hydroxide solutions of specific gravity 1.25, supply 135 g, mix potassium peroxodisulfate ( $K_2S_2O_8$ ) for 1 hour, and it dries after filtration / flush, The complex particle which covers the particle surface of nickel hydroxide with oxy cobalt hydroxide was produced. This complex particle 100 weight section and 1 weight % methyl cellulose solution 20 weight section as a binder were kneaded, the paste was adjusted, it was filled up with this paste in the pore of nickel foam (95% of porosity, 200 micrometers of average pore sizes), pressing was dried and carried out, and the non-sintering nickel pole was produced. This non-sintering nickel



pole is the conventional electrode of the indication to JP,H8-24041,B. Encapsulated type alkaline battery Y was produced like Embodiment 1 except having used this non-sintering nickel pole as an anode.

(Comparative example 3) After the nickel hydroxide 100g was immersed for 10 minutes, agitating 30weight % to 1000 ml of sodium hydroxide, and a mixed water solution with 1000 ml of 12 weight % sodium hypochlorite aqueous solutions, it washed, and it dried and the \*\* exception produced nickel oxyhydroxide. Thus, into the mixture which mixed the obtained nickel oxyhydroxide and nickel hydroxide by 10:90, five weight sections, in addition an active material mixture were obtained for the cobalt metal. This active material mixture 100 weight section and 1 weight % methyl cellulose solution 20 weight section as a binder were kneaded, the paste was prepared, into the pore of nickel foam (95% of porosity, 200 micrometers of average pore sizes), it filled up and dried, pressing of this paste was carried out, and the non-sintering nickel pole was produced. This non-sintering nickel pole is the conventional electrode of the indication to JP,S60-254564,A. Encapsulated type alkaline battery Z was produced like Embodiment 1 except having used this non-sintering nickel pole as an anode.

After charging by 0.1C at 25 \*\* about <comparison of each battery characteristic> each battery for 16 hours, the electric discharge capacity C1 (mAh) of 9 cycle deed and 9 cycle eye of each battery was calculated for the charge and discharge which make one cycle the process discharged to 1.0V by 1C at 25 \*\*. Subsequently, after charging each battery by 0.1C at 25 \*\* for 16 hours, it discharged to 1.0V by 4C at 25 \*\*, and the electric discharge capacity C2 (mAh) of 10 cycle eye of each battery was calculated. About each battery, the ratio P (%) of the electric discharge capacity C2 to the electric discharge capacity C1 was computed. The ratio P is an index which shows the quality of the high rate discharging characteristic of each battery, and its high rate discharging characteristic is so good that this value is large. A result is shown in Table 1. The electric discharge capacity of 9 cycle eye of each battery in Table 1 is the relative index which set electric discharge capacity of 9 cycle eye of the battery A1 to 100.

[0033]

[Table 1]

電池	9サイクル目の 放電容量 (C1)	比率P(%)
A1	100	89
A2	104	91
A3	100	89
X	90	69
Y	92	70
Z	92	70

[0034]As shown in Table 1, compared with the battery X, Y, and Z, the batteries A1-A3 have the large electric discharge capacity of 9 cycle eye, and, moreover, their ratio P is large. This result shows that an encapsulated type alkaline battery with large electric discharge capacity in high rate discharge is obtained compared with the case where an electrode is conventionally used by using this invention electrode.

[Experiment 2] In this experiment 2, the kind of alloying element mixed to the 1st active material and the 2nd active material was replaced with, and the electrode characteristic and the battery characteristic were compared.

(Embodiment 4: When changing the alloying element to the 1st active material) It replaces with the zinc sulfate in Embodiment 2 of the above-mentioned experiment 1, Magnesium (Mg), calcium (Ca), manganese (Mn), aluminum (aluminum), Cadmium (Cd), yttrium (Y), cobalt (Co), bismuth (Bi), A non-sintering nickel pole and the alkaline batteries B1-B13 were obtained like Embodiment 2 except having used sulfate of lanthanum (La), ytterbium (Yb), erbium (Er), gadolinium (Gd), and cerium (Ce).

(Embodiment 5: When changing the alloying element to the 2nd active material) Ammonium sulfate salt was added in the solution which mixed zinc sulfate with nickel sulfate by the weight ratio 99.5:0.5, and nickel and zincky ammine complex ion were formed in it. This liquid was dropped at sodium hydroxide solution, and zinc produced the nickel hydroxide which dissolved 0.5weight %. The 1st and 2nd active materials were obtained by the same method as the above-mentioned Embodiment 1 using this nickel hydroxide 100g. Except that active materials differed, the non-sintering nickel pole and the encapsulated type alkaline battery B14 were obtained like Embodiment 1.

(Embodiment 6) It replaced with zinc sulfate in the above-mentioned Embodiment 5, and the non-sintering nickel pole and the alkaline battery B15 were obtained like the above-mentioned Embodiment 5 except having used magnesium sulfate.

(Embodiment 7) In the above-mentioned Embodiment 5, nickel sulfate, The non-sintering nickel pole and the encapsulated type alkaline battery B16 were obtained like the above-mentioned Embodiment 5 except having produced the nickel hydroxide which mixed zinc sulfate and cobalt sulfate by the weight ratio 99:0.5:0.5 and in which zinc and cobalt dissolved 0.5weight % respectively.

[0035]These batteries were prepared and the battery characteristic was compared like said experiment 1. This result is shown in Table 2.

[0036]

[Table 2]

電池	第1の活物質 への添加元素	第2の活物質 への添加元素	9サイクル目の 放電容量(C1)	比率P (%)
A1	—	—	100	89
A2	Zn	—	106	91
B1	Mg	—	105	91
B2	Ca	—	105	91
B3	Mn	—	106	91
B4	Al	—	105	91
B5	Cd	—	105	91
B6	Y	—	106	91
B7	Co	—	105	91
B8	Bi	—	106	91
B9	La	—	105	91
B10	Yb	—	105	91
B11	Er	—	105	91
B12	Gd	—	105	91
B13	Ce	—	105	91
B14	Zn	Zn	108	92
B15	Mg	Mg	108	92
B16	Zn+Co	Zn+Co	110	93

[0037]the battery A1 and B1-B13 which added the alloying element to the 1st active material rather than the battery A1 which does not have an alloying element in the 1st active material and 2nd active material from this result -- further, It is understood that the battery B14 and B15 which added the alloying element to the 1st and 2nd active materials, and the battery B16 which added two or more alloying elements to the 1st and 2nd active materials have the outstanding battery characteristic.

[Experiment 3] In this experiment 3, the relation of the mixing ratio of nickel hydroxide and nickel oxyhydroxide, i.e., the mixing ratio of the 1st active material and the 2nd active material, and the high rate discharging characteristic of a battery was investigated.

[0038]First, the nickel hydroxide (the 1st active material) covered with oxy cobalt hydroxide, The mixing ratio of the nickel oxyhydroxide (the 2nd active material) covered with oxy cobalt hydroxide was replaced with the weight ratio 80:20 of said Embodiment 1, and the mixture set to 95:5, 90:10, 70:30, 60:40, and 50:50 (five kinds) was produced. The encapsulated type alkaline batteries C1-C5 were produced like the above-mentioned Embodiment 1 except having used five kinds of this mixture as positive active material. About each battery, the charge-and-discharge cycle test of the same conditions as the previous experiment 1 was done, and it asked for the ratio P of the electric discharge capacity of 9 cycle eye to the electric

discharge capacity C1 of 9 cycle eye of each battery. This result is shown in Table 3. The result of the battery A1 is also shown in Table 3, and Q in Table 3 is the relative index which set the ratio P of the electric discharge capacity of 10 cycle eye to the electric discharge capacity C1 of 9 cycle eye of the battery A1 (89%) to 100. A battery with a larger value of Q has a better high rate discharging characteristic.

[0039]

[Table 3]

電池	第 1 の活物質 (重量%)	第 2 の活物質 (重量%)	Q
C 1	9 5	5	8 5
C 2	9 0	1 0	9 8
A 1	8 0	2 0	1 0 0
C 3	7 0	3 0	1 0 0
C 4	6 0	4 0	9 9
C 5	5 0	5 0	電池重量減

[0040]As shown in Table 3, the battery A1, C2 - C4 have a large value of Q compared with the battery C1. After the charge and discharge of 3 cycle eye, since 50 mg of weight loss arose, the battery C5 interrupted the examination. In order for a high rate discharging characteristic to obtain the non-sintering nickel pole which gives a good encapsulated type alkaline battery from this result, it is good to use the active material which mixed nickel hydroxide (the 1st active material) and nickel oxyhydroxide (the 2nd active material) with the wt. ratios 90:10-60:40.

[0041]And also especially in this, electric discharge capacity is the maximum and the battery A1 using the active material set to 80:20-70:30 with the wt. ratio and C3 can call the optimal range the mixing ratio of the 1st active material and the 2nd active material.

[Experiment 4] In this experiment 4, in the 1st active material, the ratio in the cobalt atom conversion of oxy cobalt hydroxide to nickel hydroxide was changed, and the relation with the electric discharge capacity of a battery was investigated. The ratio of oxy cobalt hydroxide to the nickel oxyhydroxide in the 2nd active material is fixed to 5weight % by cobalt atom conversion. The wt. ratio of the 1st active material and the 2nd active material is fixed to 80:20.

[0042]The amount of the cobalt sulfate used at the time of producing the nickel hydroxide (the 1st active material) which covered oxy cobalt hydroxide is replaced with 13.1 g (equivalent to 5 weight % at cobalt atom conversion), 0.78g, 1.3g, 2.7g, 7.8g, 18.3g, 26.3g, 31.5g, and 39.4g ( [ cobalt atom conversion ] In order, the alkaline batteries D1-D8 were produced in order like Embodiment 1 except having considered it as 0.3 weight %, 0.5 weight %, 1.0 weight %, 3.0 weight %, 7.0 weight %, 10.0 weight %, 12.0 weight %, and 15.0 weight %. Details are

combined with the result of the battery A1, and are shown in Table 4.

[0043]

[Table 4]

電池	硫酸コバルト使用量 (g)	コバルト原子換算 (重量%)
D 1	0. 7 8	0. 3
D 2	1. 3	0. 5
D 3	2. 7	1. 0
D 4	7. 8	3. 0
A 1	13. 1	5. 0
D 5	18. 3	7. 0
D 6	26. 3	10. 0
D 7	31. 5	12. 0
D 8	39. 4	15. 0

[0044]About each above-mentioned battery, the charge-and-discharge cycle test of the same conditions as the point was done, and the electric discharge capacity C1 of 9 cycle eye of each battery was calculated. This result is shown in drawing 1.

[0045]In drawing 1, a vertical axis shows the ratio (weight %) in cobalt atom conversion of on the 1st active material and as opposed to [ in a horizontal axis ] nickel hydroxide for the electric discharge capacity of 9 cycle eye of oxy cobalt hydroxide, respectively. This vertical axis is denoted by the relative index which set electric discharge capacity of 9 cycle eye of the battery A1 to 100.

[0046]In the 1st active material, drawing 1 shows that it is necessary to make the ratio in the cobalt atom conversion of oxy cobalt hydroxide to nickel hydroxide into 1.0 to 10.0 weight %, in order to obtain the non-sintering nickel pole where electric discharge capacity is large.

[Experiment 5] In this experiment 5, in the 2nd active material, the ratio in the cobalt atom conversion of oxy cobalt hydroxide to nickel oxyhydroxide was changed, and the relation with the electric discharge capacity of a battery was investigated. The ratio of oxy cobalt hydroxide to nickel hydroxide in the 1st active material is fixed to 5weight % by cobalt atom conversion. The wt. ratio of the 1st active material and the 2nd active material is fixed to 80:20.

[0047]The amount of the cobalt sulfate used at the time of producing the nickel oxyhydroxide (the 2nd active material) covered with oxy cobalt hydroxide is replaced with 13.1 g (equivalent to 5 weight % at cobalt atom conversion), 0.78g, 1.3g, 2.7g, 7.8g, 18.3g, 26.3g, 31.5g, and 39.4g () [ cobalt atom conversion ] In order, the alkaline batteries E1-E8 were produced in order like Embodiment 1 except having considered it as 0.3 weight %, 0.5 weight %, 1.0 weight %, 3.0 weight %, 7.0 weight %, 10.0 weight %, 12.0 weight %, and 15.0 weight %. Details are

combined with the result of the battery A1, and are shown in Table 5.

[0048]

[Table 5]

電池	硫酸コバルト使用量 (g)	コバルト原子換算 (重量%)
E 1	0. 7 8	0. 3
E 2	1. 3	0. 5
E 3	2. 7	1. 0
E 4	7. 8	3. 0
A 1	1 3. 1	5. 0
E 5	1 8. 3	7. 0
E 6	2 6. 3	1 0. 0
E 7	3 1. 5	1 2. 0
E 8	3 9. 4	1 5. 0

[0049]About each above-mentioned battery, the charge-and-discharge cycle test of the same conditions as the point was done, and the electric discharge capacity C1 of 9 cycle eye of each battery was calculated. This result is shown in drawing 2.

[0050]In drawing 2, a vertical axis shows the ratio (weight %) in cobalt atom conversion of on the 2nd active material and as opposed to [ in a horizontal axis ] nickel oxyhydroxide for the electric discharge capacity of 9 cycle eye of oxy cobalt hydroxide, respectively. The vertical axis of drawing 2 is denoted by the relative index which set electric discharge capacity of 9 cycle eye of the battery A1 to 100.

[0051]In order to obtain the non-sintering nickel pole where electric discharge capacity is large, it is more desirable in the 2nd active material to make the ratio in the cobalt atom conversion of oxy cobalt hydroxide to nickel oxyhydroxide into 1.0 to 10.0 weight % than in drawing 2.

[0052]

[Effect of the Invention]By this invention, the non-sintering nickel pole which gives an encapsulated type alkaline battery with large electric discharge capacity in high rate discharge is provided.

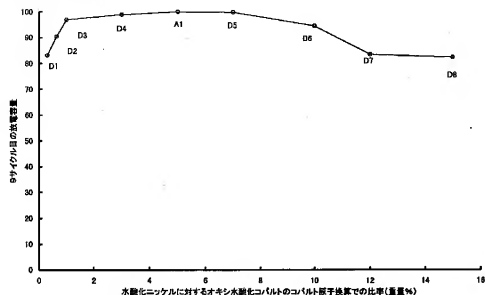
[Brief Description of the Drawings]

[Drawing 1]It is a graph in which the ratio in the cobalt atom conversion of oxy cobalt hydroxide to nickel hydroxide in the 1st active material and the relation of the electric discharge capacity of a battery are shown.

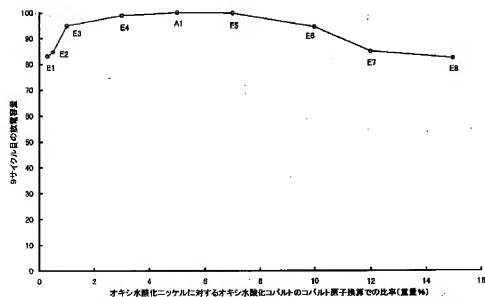
[Drawing 2]It is a graph in which the ratio in the cobalt atom conversion of oxy cobalt hydroxide

to nickel oxyhydroxide in the 2nd active material and the relation of the electric discharge capacity of a battery are shown.

[Drawing 1]



[Drawing 2]



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[Translation done.]